Garden City, Missouri
Water Supply Study
City Lake

Garden City is located in the Southeast corner of Cass County, Missouri. It is 10 miles South East of Harrisonville on Highway 7.

The record period of drought was used to estimate if Garden City water supply is adequate to provide ample water for the city. The 1950's were determined to be the drought of record.

The 30-year average rainfall is approximately 42 inches. Rainfall at the Harrisonville gage was used in this analysis. For the period of the severest part of the drought of 1953 through 1957, annual rainfall was 28.8, 35.7, 28.4, 21.3, and 37.5 inches.

Garden City has two lakes, an older lake and their new lake. The new lake was constructed 1992 and the city began using the water in 1994. This lake is located 2 miles south and 1 1/4 mile East of Garden City. Its drainage area is 1.70 square miles. The old lake is located 1 mile east of town and has a drainage area of 0.67 square miles. Prior to 1994 the old lake was the main source of water for the community. The operating plan is to use whichever lake has a supply that meets their needs.

In year 2000 the older lake provided 20,311,090 gallon of water or 55,646 gallons per day and the new lake provided 29,889,810 gallons or 81,890 gallons per day. The total was 50,200,900 gallons for an average daily use of 137,536 gallons per day.

The optimized demand for Year 2000 was 69,000 gallons per day for the old lake and 182,000 gallons per day for the new lake.

Garden City's Lake analysis consisted of using the NRCS's computer program "RESOP". This program analyzes remaining stored water at the end of each month by summing gains and losses.

Following is the data and procedures for input to the "RESOP" program.

STO-AREA Elevation-Storage and Elevation-Area data were determined from April 6, 2004 surveys of both lakes made by USGS.

Garden City (Old) Lake

Elevation Feet	Area Acres	Volume Acre Feet	
878	0.15	0.02	
880	1.7	1.7	
882	5.1	7.8	
884	10.2	24.4	
886	13.6	48.2	
888	19.3	81.4	
890	23.4	124.7	
892	26.1	174.3	
892.1	27.1	177.0	Spillway Elevation
893	30.4	202.9	Emergency Spillway Elevation
894	33.5	234.9	
895	36.8	270.0	Top of Dam

Garden City (New) Lake

Elevation Feet	Area Acres	Volume Acre Feet	
842	0.3	0.2	
844	2.5	2.9	
846	5.0	10.5	
848	7.9	23.4	
850	12.4	43.7	
852	16.2	72.6	
854	20.1	108.8	
856	23.8	152.7	
858	27.7	203.7	
860	33.7	264.7	
862	39.3	337.7	
862.4	40.5	353.7	Water Surface 6/2004
864	8.8	426.1	
864.3	49.9	440.9	Spillway Elevation
866	57.4	532.0	
867.2	63.0	604.2	Top of Dam

		New Lake	Old Lake
LIMITS	Full Pool storage	440.9 Ac.Ft.	177.0 Ac.Ft.
	Minimum Pool storage	50 Ac.Ft.	10 Ac.Ft.
	Drainage Area	1.70 Sq.Mi.	0.67 Sq.Mi.

Starting storage was considered at full pool elevation.

GENERAL The adjustment factor of 0.76 to convert from pan evaporation to lake evaporation was applied prior to entering the data for the control word EVAP. As a result a factor of 100 is applied.

The record period of drought is in the 1950's.
Analysis began in January 1951 and ended December 1959

SEEPAGE The reservoir seepage varied from 0 seepage near empty to a maximum of 1.00 inch per Month at full pool for each lake. The material in each dam is compacted earth of clayey soils.

RAINFALL Rainfall data came from the Harrisonville, Mo. rain gage for the period 1951 through 1959.

RUNOFF This is the runoff into the lake from its drainage area. Regional monthly runoff values were determined from stream gage data.

Monthly runoff volumes in watershed inches was determined at the Little Blue River gage near Lake City, Another gage on Cedar Creek near Pleasant View, Missouri was analyzed. Results at the lake were nearly the same. Because Little Blue River watershed is nearer to Garden City, and the soils and topography of Little Blue River is more nearly like that at Garden City, it was selected to present regional runoff.

If runoff did not appear reasonable when compared to rainfall, it was necessary to examine daily rainfall values for that month. Anticedent moisture was estimated for each rainfall event and adjustments to NRCS runoff curve number was made to arrive at runoff for each storm.

EVAP. Pan evaporation at the Lakeside gaging station near the Lake of the Ozarks was used to determine Pan evaporation. The adjustment to Lake Evaporation was 0.76.

DEMAND Garden City demand came from their reporting as a major water user to the department of natural Resources. In year 2000 they reported using a total of 50,200,900 gallons, (0.138 MGD) from the two lakes.

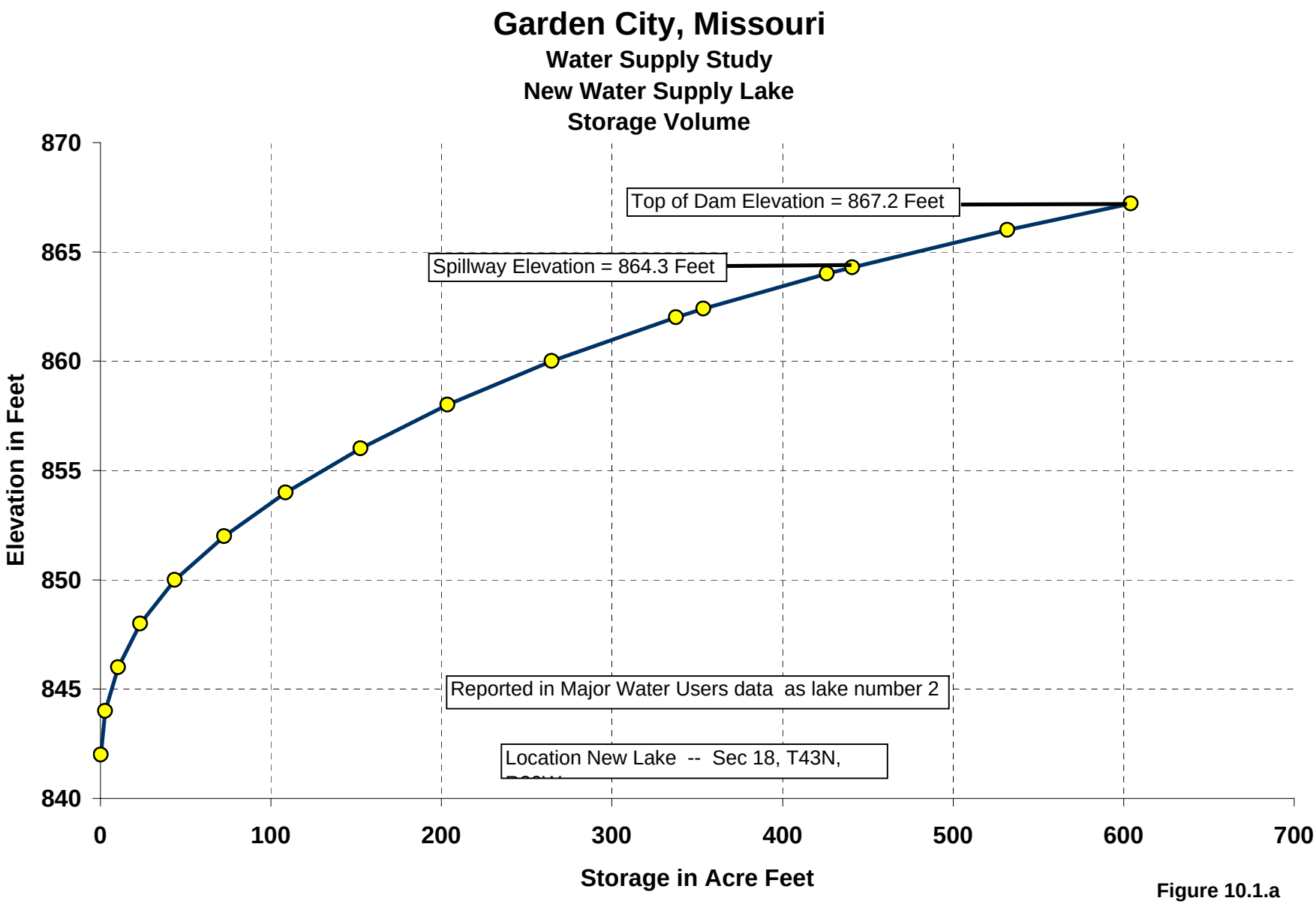

Garden City, Missouri
Water Supply Study
New Water Supply Lake
Storage Volume
Top of Dam Elevation = 867.2 Feet
Spillway Elevation = 864.3 Feet
Reported in Major Water Users data as lake number 2
Location New Lake -- Sec 18, T43N,
Elevation in Feet
870
865
860
855
850
845
840
0
100
200
300
400
500
600
700
Storage in Acre Feet

Figure 10.1.a

Garden City, Missouri

Water Supply Study

New Water Supply Lake

Surface Area

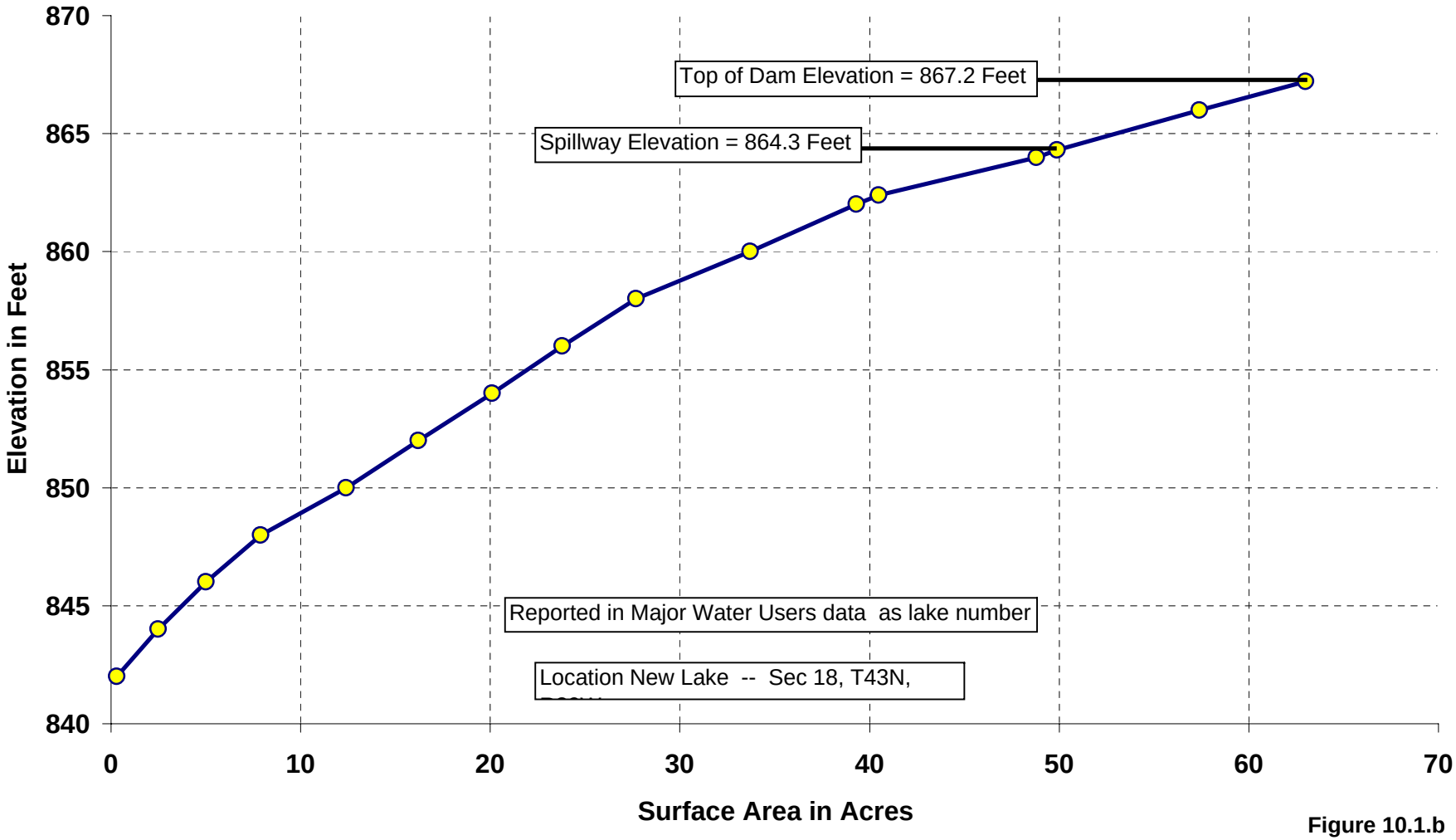


Figure 10.1.b

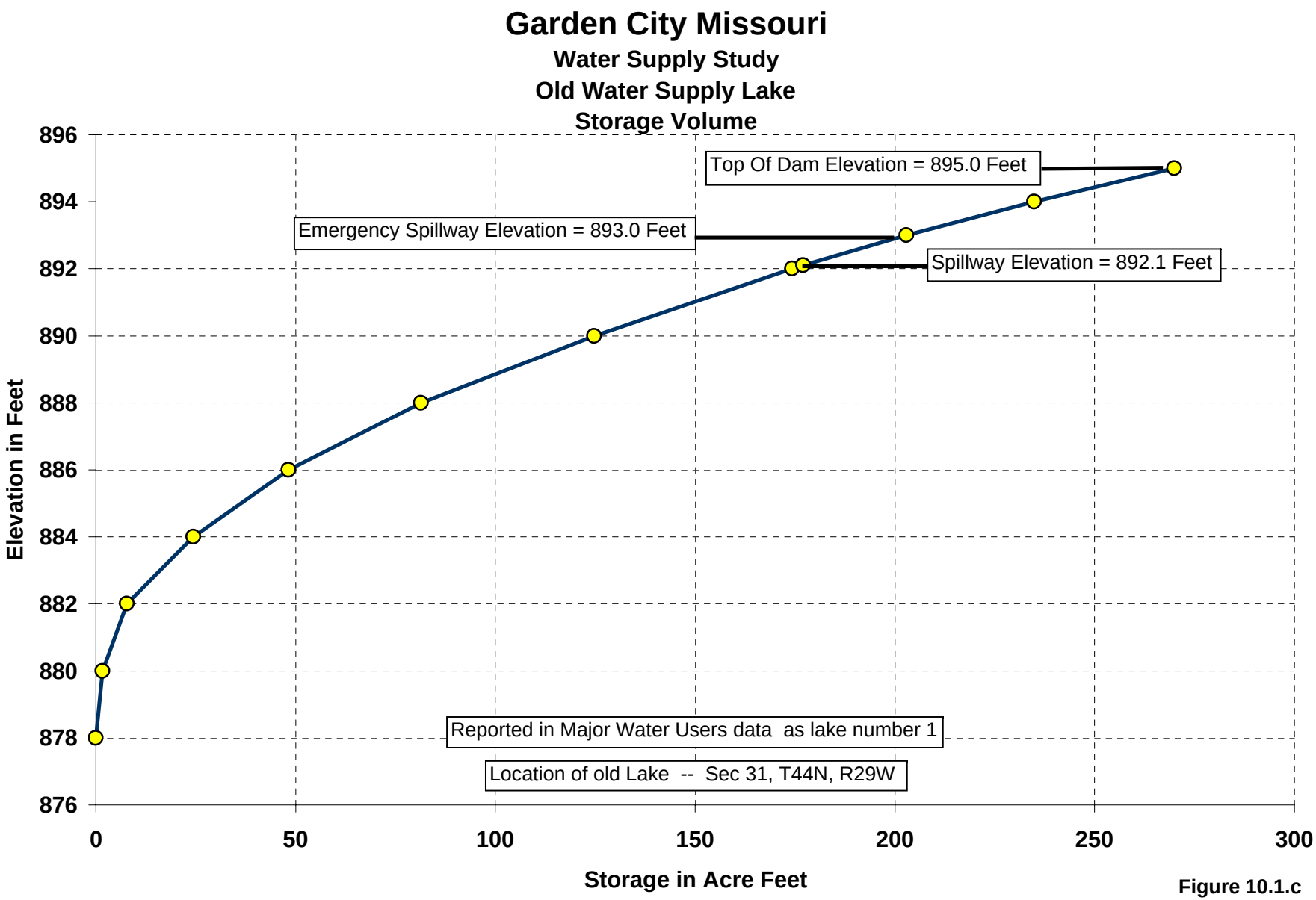

Garden City Missouri
Water Supply Study
Old Water Supply Lake
Storage Volume
Top Of Dam Elevation = 895.0 Feet
Emergency Spillway Elevation = 893.0 Feet
Spillway Elevation = 892.1 Feet
Reported in Major Water Users data as lake number 1
Location of old Lake -- Sec 31, T44N, R29W
Elevation in Feet
896
894
892
890
888
886
884
882
880
878
876
0
50
100
150
200
250
300
Storage in Acre Feet

Figure 10.1.c

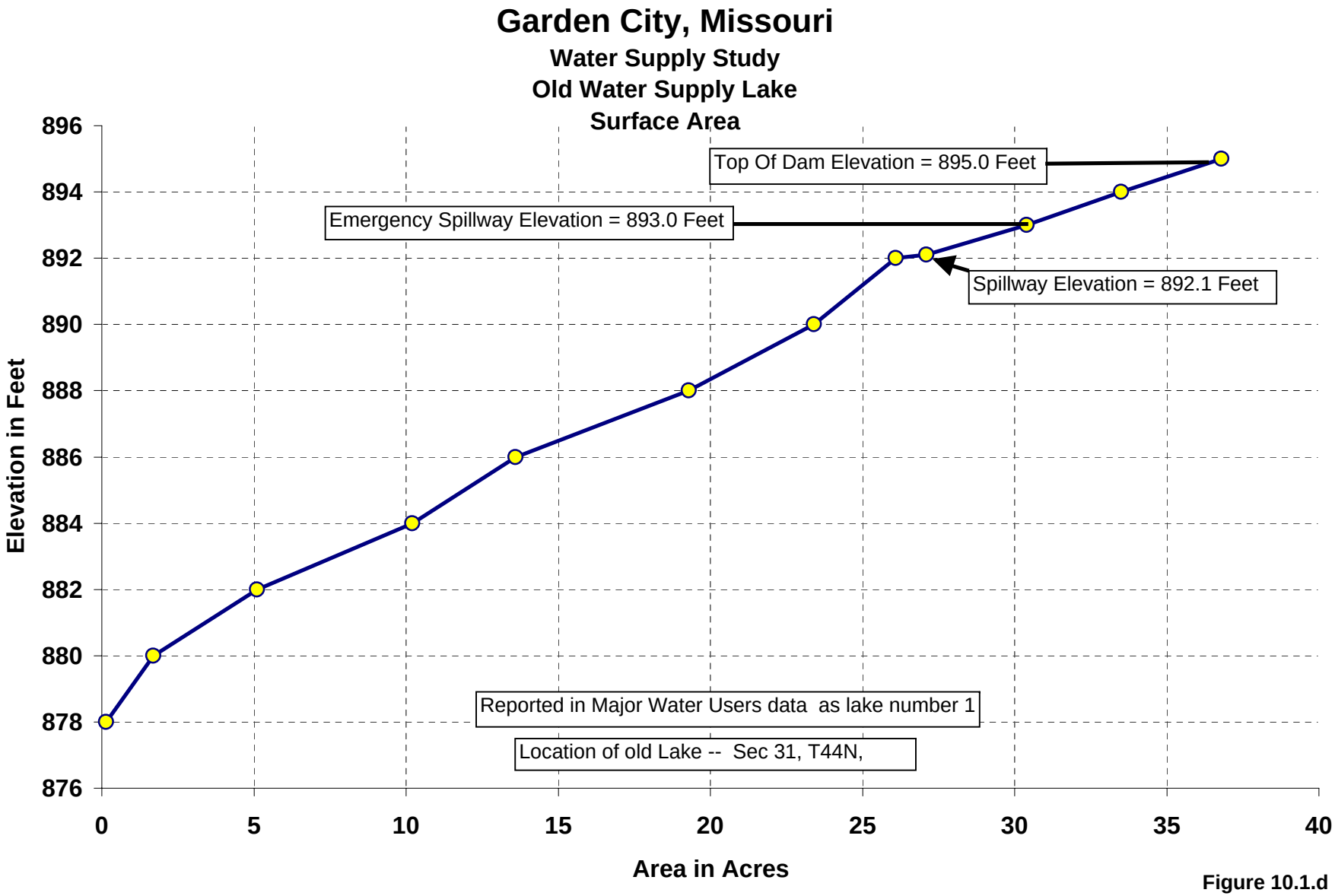

Garden City, Missouri
Water Supply Study
Old Water Supply Lake
Surface Area
Top Of Dam Elevation = 895.0 Feet
Emergency Spillway Elevation = 893.0 Feet
Spillway Elevation = 892.1 Feet
Reported in Major Water Users data as lake number 1
Location of old Lake -- Sec 31, T44N,
Elevation in Feet
896
894
892
890
888
886
884
882
880
878
876
0
5
10
15
20
25
30
35
40
Area in Acres

Figure 10.1.d

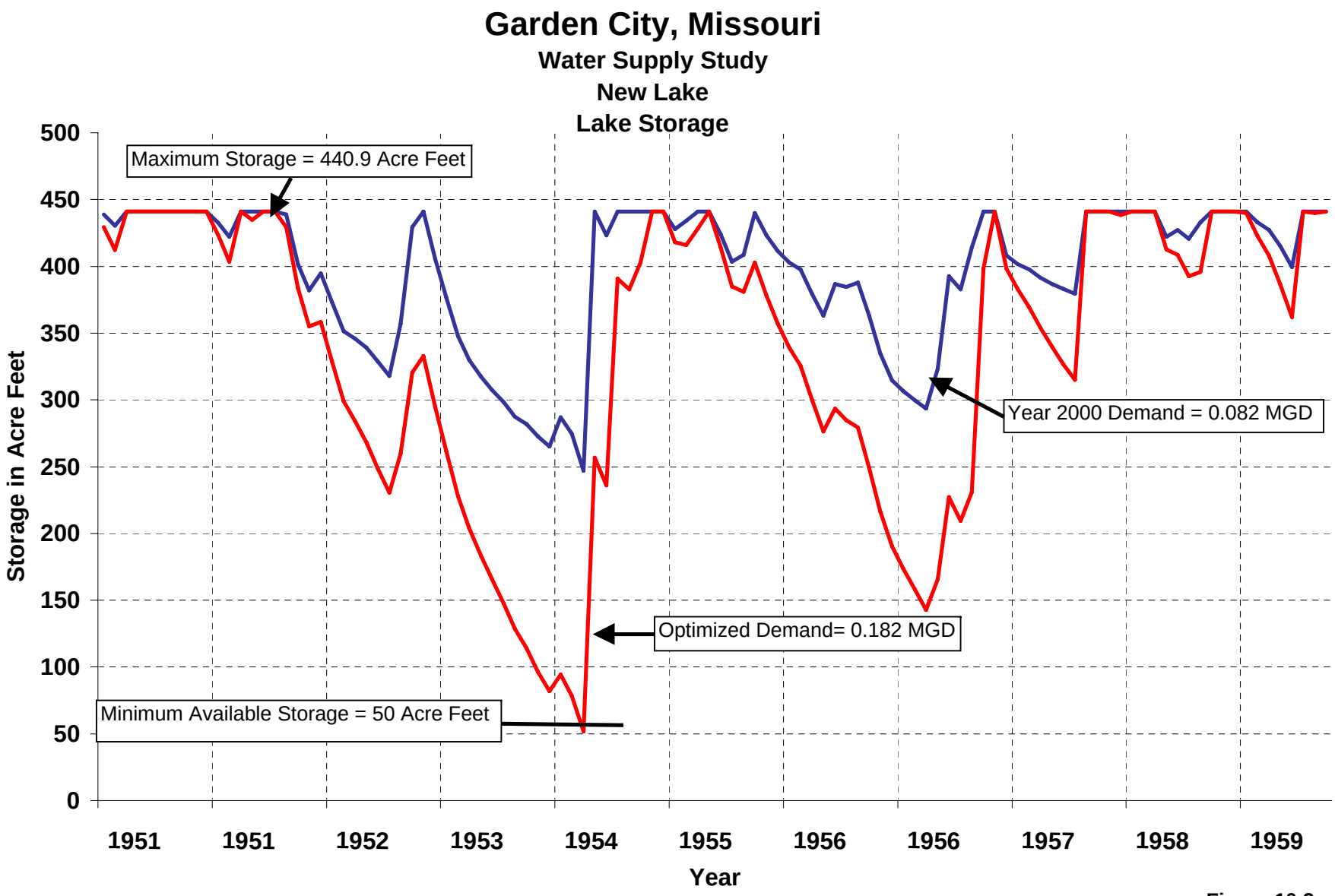

Garden City, Missouri
Water Supply Study
New Lake
Lake Storage
Maximum Storage = 440.9 Acre Feet
Year 2000 Demand = 0.082 MGD
Optimized Demand= 0.182 MGD
Minimum Available Storage = 50 Acre Feet
Storage in Acre Feet
500
450
400
350
300
250
200
150
100
50
0
1951
1951
1952
1953
1954
1955
1956
1956
1957
1958
1959
Year

Figure 10.2.a

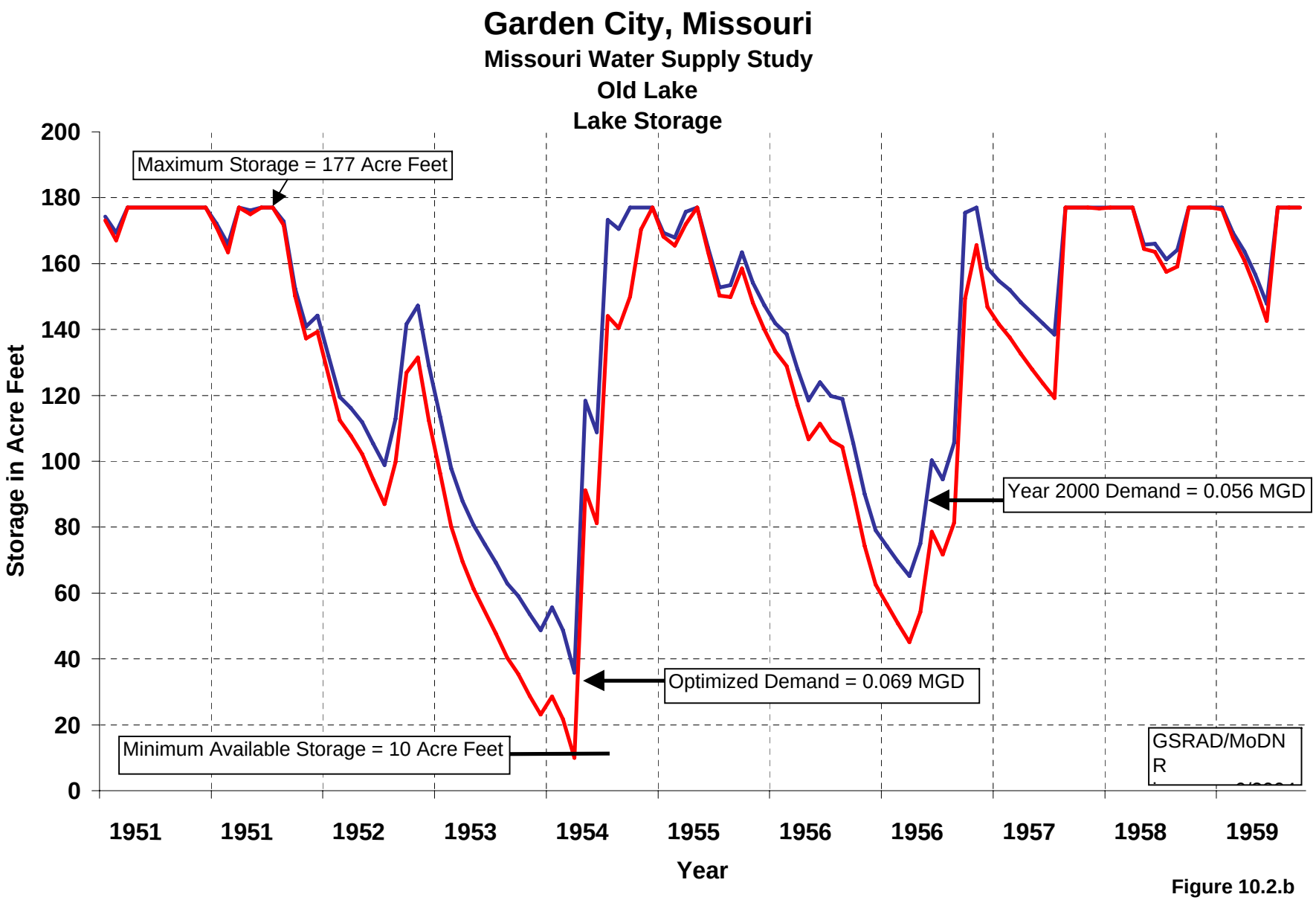

Garden City, Missouri
Missouri Water Supply Study
Old Lake
Lake Storage
Storage in Acre Feet
200
180
160
140
120
100
80
60
40
20
0
Maximum Storage = 177 Acre Feet
Year 2000 Demand = 0.056 MGD
Optimized Demand = 0.069 MGD
Minimum Available Storage = 10 Acre Feet
GSRAD/MoDNR
1951
1951
1952
1953
1954
1955
1956
1956
1957
1958
1959
Year

Figure 10.2.b

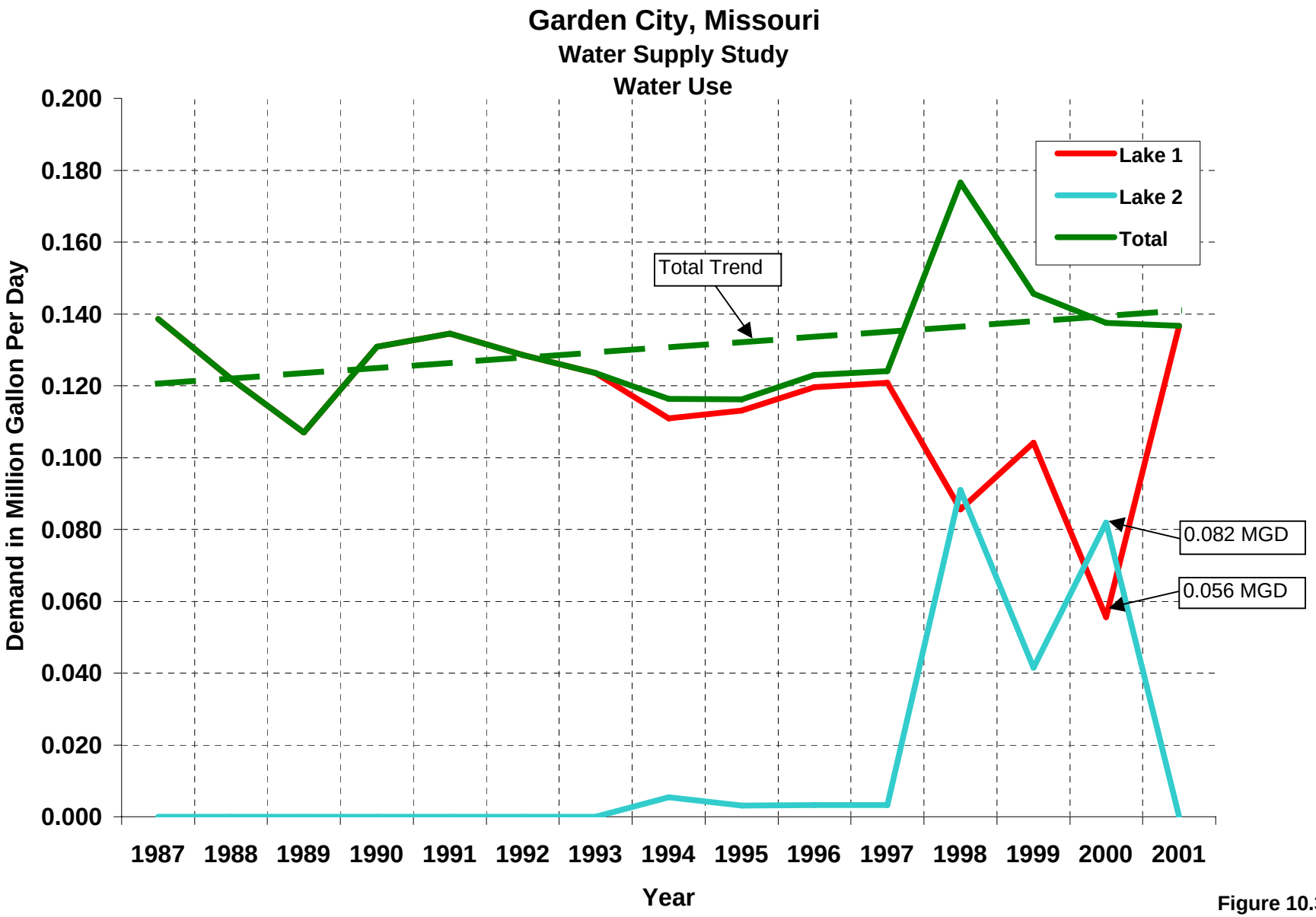
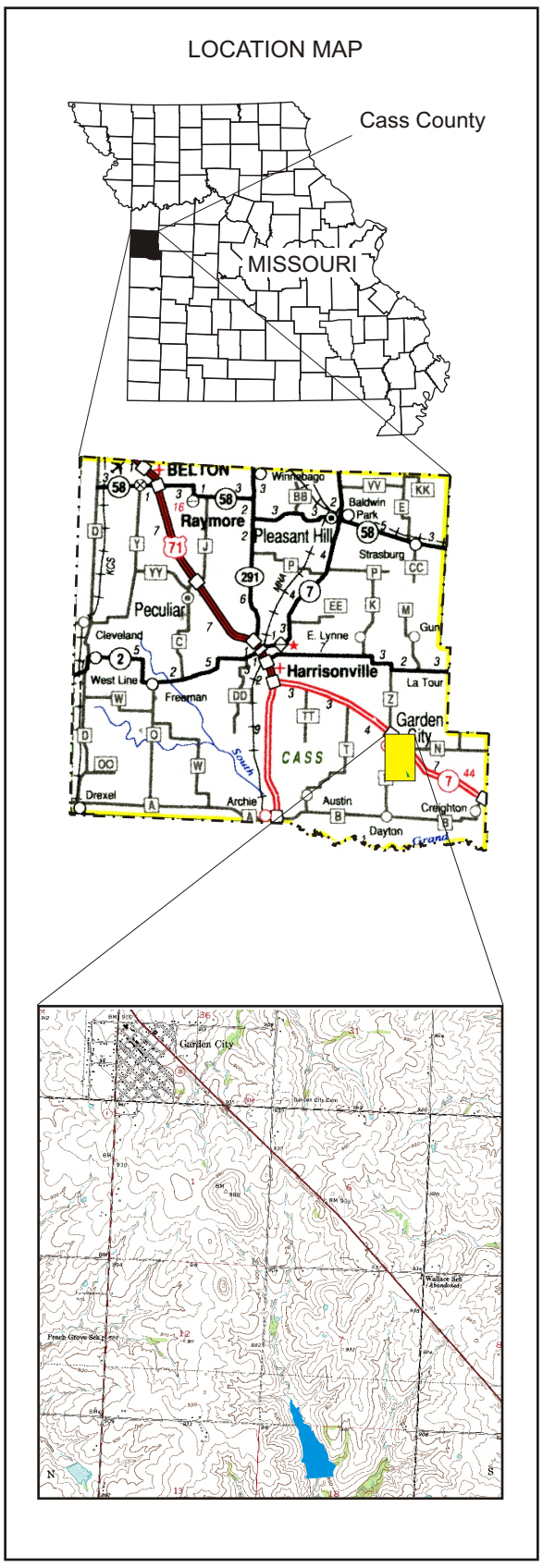

Garden City, Missouri
Water Supply Study
Water Use
Demand in Million Gallon Per Day
0.200
0.180
0.160
0.140
0.120
0.100
0.080
0.060
0.040
0.020
0.000
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
Year
Lake 1
Lake 2
Total
Total Trend
0.082 MGD
0.056 MGD

Figure 10.3

GARDEN CITY (NEW) LAKE

Elevation (feet)	Area (acres)	Volume (acre-ft)
842.0	0.3	0.2
844.0	2.5	2.9
846.0	5.0	10.5
848.0	7.9	23.4
850.0	12.4	43.7
852.0	16.2	72.6
854.0	20.1	108.8
856.0	23.8	152.7
858.0	27.7	203.7
860.0	33.7	264.7
862.0	39.3	337.7
862.4	40.5	353.7
864.0	48.8	426.1
864.3	49.9	440.9
866.0	57.4	532.0
867.2	63.0	604.2

Table 30. Lake elevations and respective surface areas and volumes. Top of spillway structure is 862.4 feet. Approximate emergency spillway and top of dam elevations are 864.3 feet and 867.2 feet respectively. Elevations referenced to North American Vertical Datum 1988 (NAVD 88).



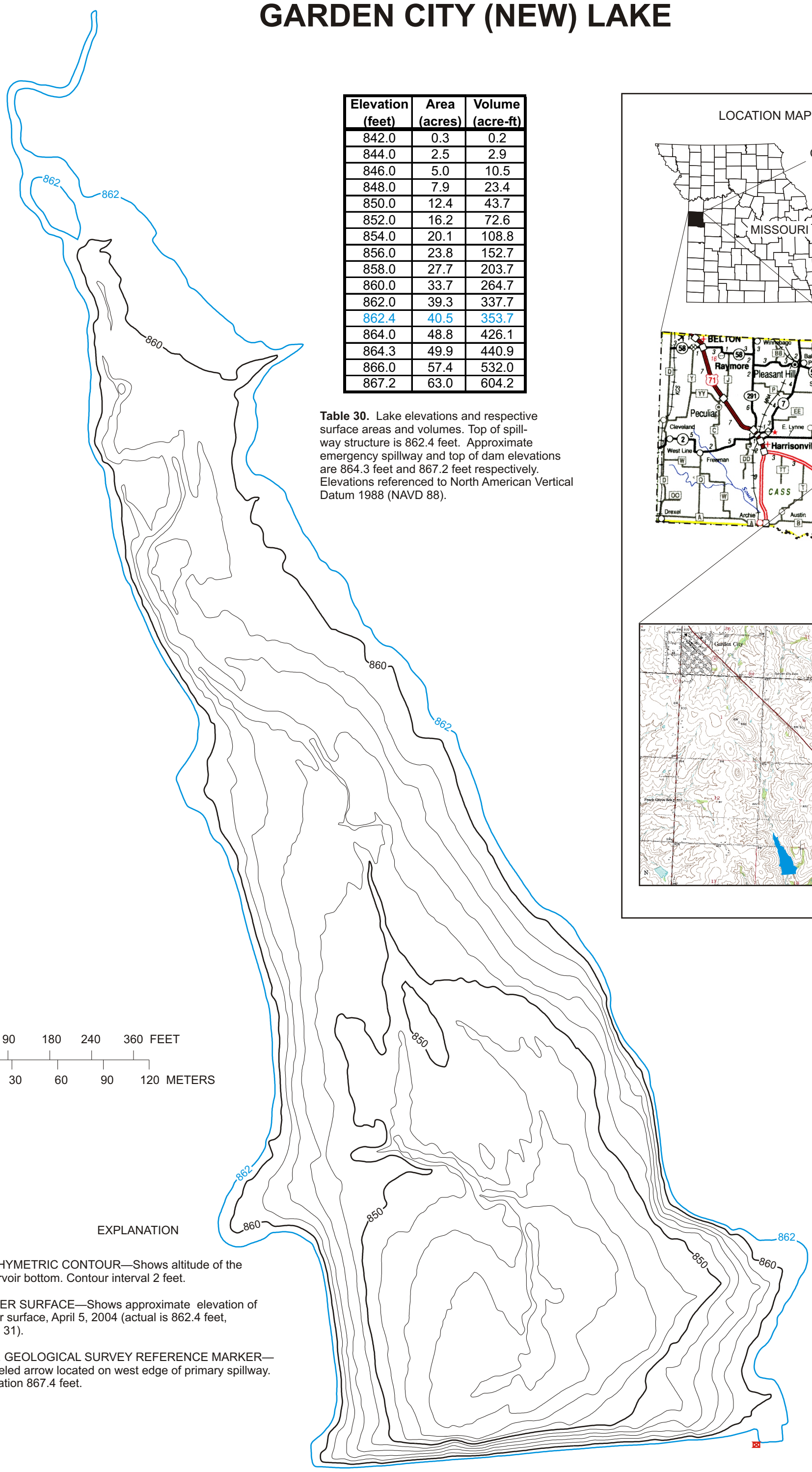


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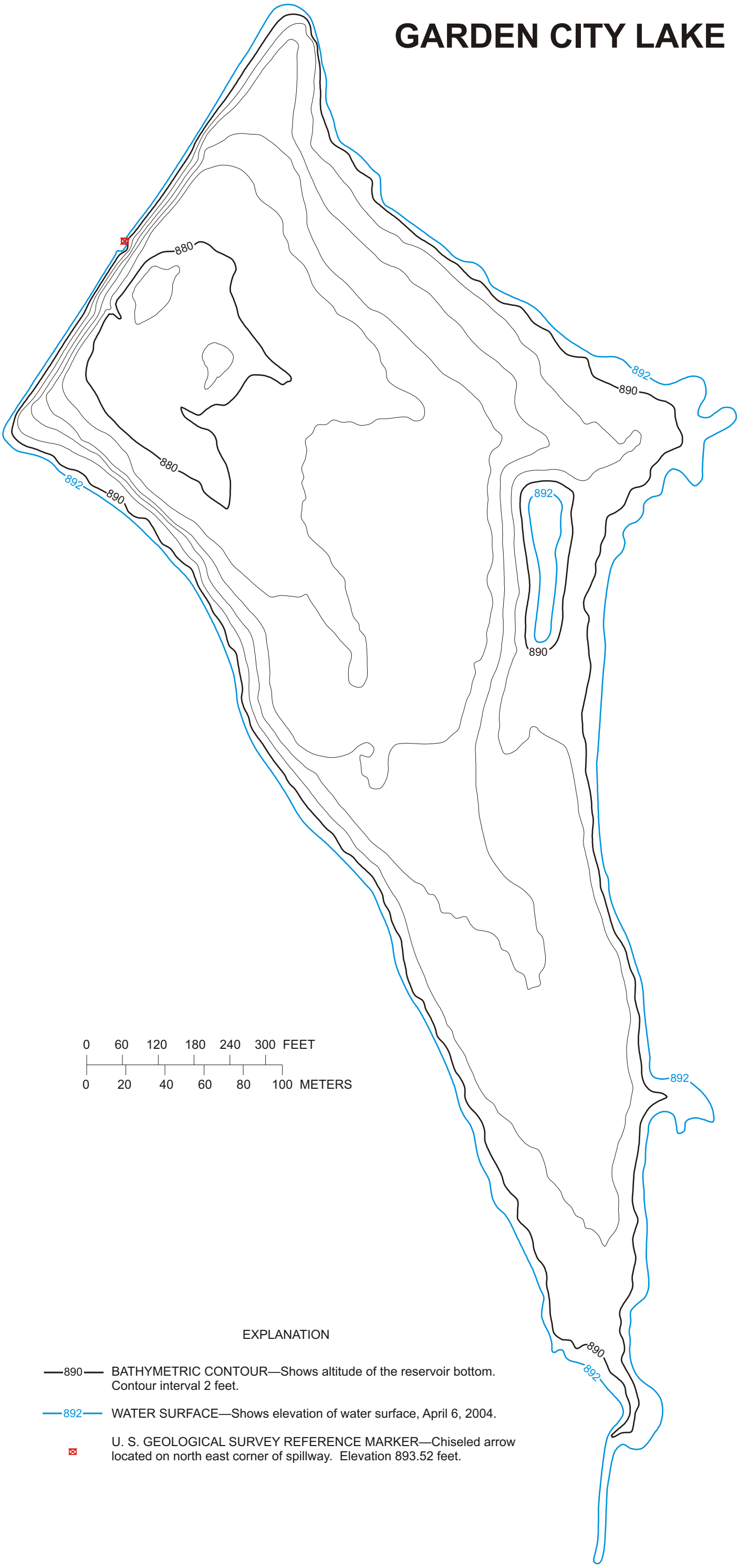
Figure 30. Bathymetric map and table of areas/volumes of the Garden City (New) Lake near Garden City, Missouri.

In cooperation with Missouri Department of Natural Resources

GARDEN CITY LAKE



0 60 120 180 240 300 FEET

0 20 40 60 80 100 METERS

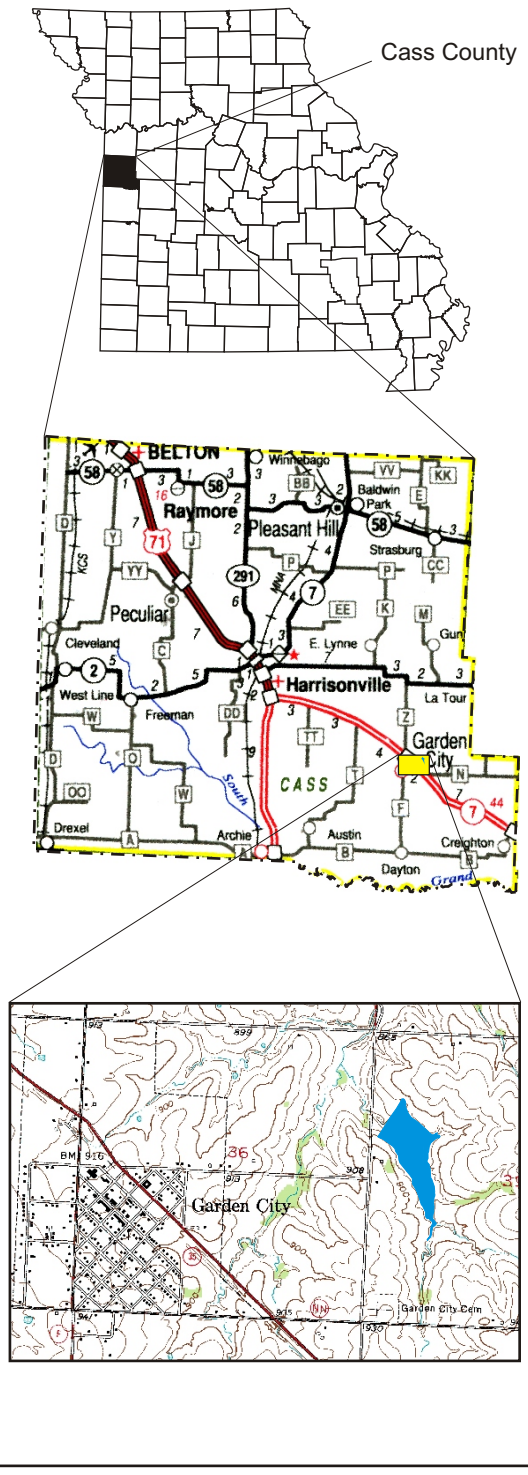
EXPLANATION

—890— BATHYMETRIC CONTOUR—Shows altitude of the reservoir bottom. Contour interval 2 feet.

—892— WATER SURFACE—Shows elevation of water surface, April 6, 2004.

U. S. GEOLOGICAL SURVEY REFERENCE MARKER—Chiseled arrow located on north east corner of spillway. Elevation 893.52 feet.

LOCATION MAP



Elevation (feet)	Area (acres)	Volume (acre-ft)
878.0	0.15	0.02
880.0	1.7	1.7
882.0	5.1	7.8
884.0	10.2	24.4
886.0	13.6	48.2
888.0	19.3	81.4
890.0	23.4	124.7
892.0	26.1	174.3
892.1	27.1	177.0
893.0	30.4	202.9
894.0	33.5	234.9
895.0	36.8	270.0

Table 29. Lake elevations and respective surface areas and volumes. Top of spillway structure is 892.1 feet. Approximate emergency spillway and top of dam elevations are 893.0 and 895.0 feet respectively. Elevations referenced to North American Vertical Datum 1988 (NAVD 88).

USGS science for a changing world

Figure 29. Bathymetric map and table of areas/volumes of the Garden City Lake near Garden City, Missouri.

In cooperation with Missouri Department of Natural Resources